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New Code May Be Key to Atom Test Ban Treaty

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Each time the United States tests a nuclear weapon beneath the Nevada desert, a network of stations in North America automatically records the seismic disturbance and feeds the data by satellite to a laboratory in Albuquerque. The stations accurately report that a bomb was exploded and give its location and size.

These automated seismic installations are an experimental network that the United States is developing as a revolutionary means of verifying a comprehensive nuclear test ban treaty, should one ever be negotiated with the Soviet Union.

Unlike other means of verification, these black boxes, 6 inches wide and 4½ feet long, would be buried in Soviet soil, and the Soviets would place similar sensors in the United States to monitor American testing.

Technology Proved

The technology for this has long been proved, but implementation was not feasible until the development of a new class of mathematical codes. Using these codes, both nations could read the seismic messages being sent out, but neither could send fake messages to fool or discredit the other. This would be one of the most important and interesting applications of this new mathematics, which is commonly called public-key cryptography.

In fact, such a system of automated verification was the key to the comprehensive nuclear test ban treaty that the United States and the Soviet Union came close to concluding near the end of the Jimmy Carter Administration.

Although the Reagan Administration has backed off from such a comprehensive test ban, the means for verifying one remain very much alive and under study.

"Up to now, we've negotiated treaties in areas where verification could be managed by so-called national means: what you can do either from your own sovereign territory or the territory of your allies or from satellites," said Gustavus J. Simmons of Sandia Laboratories in Albuquerque, a national defense lab that has developed the system and continues to test it.

"This one is fundamentally different," he said. "It's the first time we have ever negotiated toward a treaty in which the party being monitored cooperates to some extent in the monitoring. It is basically a different approach to verification of treaties than what we've had before."

Verification has been a stumbling block of arms control as long as the superpowers have discussed it. The Soviets do not like the idea of on-site inspections and, until recently, they have steadfastly opposed it. At the same time, the United States has been unwilling to commit to any treaty without some way of ensuring compliance.

Atmospheric testing raised public concern in the 1950s because of radioactive pollution in the air. However, underground testing does not carry that hazard and thus is fundamentally related to the development of new weapons.

Limiting Number of Warheads

The Reagan Administration has approached arms control by proposing to limit the number of warheads and missiles on both sides. However, under such an agreement, each side could continue to improve the quality of its weapons as long as it did not increase their numbers. Enhanced-radiation warheads, for example, change the character of the weapons without changing the number of weapons in the stockpile.

However, with a comprehensive test ban, weapons technology essentially is frozen. Neither side would want to deploy a new weapons system without testing it.

Although the 1963 treaty banning nuclear tests in the atmosphere and in space can be verified by the existing seismic network or by satellite, underground tests are more difficult to detect. Although the United States maintains a seismic network in Europe that keeps an eye on the Soviet test sites, there is a threshold below which significant tests can be conducted and not be noticed.

"Sitting in Europe and watching the interior of Russia, the threshold of what you can detect is sufficiently high that meaningful development of weapons technologies could go on undetected," Simmons said. "In order to stop the development of new weapons, it's necessary to bring that threshold down to a much lower level. And, to do that, you have to get in closer."

The automated seismic stations would allow both countries to "get in closer" without arousing Soviet fears of on-site inspections.

The development of unattended seismic observatories began more than 20 years ago, during the Administration of John F. Kennedy, more as a technical challenge than as a political reality. The Soviets would not hear of the idea then.

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